

US EPA ARCHIVE DOCUMENT



## Restoring America's Greatest River

***Presented at the water quality technical section of the  
annual meeting of the LMRCC, 9/16/06 at Vicksburg,  
MS***



# **Environmental Monitoring and Assessment of Great River Ecosystems (EMAP-GRE)**

## **Overview and Design Considerations for the Lower Mississippi River**

US EPA Office of Research & Development  
National Health & Environmental Effects Laboratory  
Mid-Continent Ecology Division Duluth, MN  
Angradi.Theodore@epa.gov

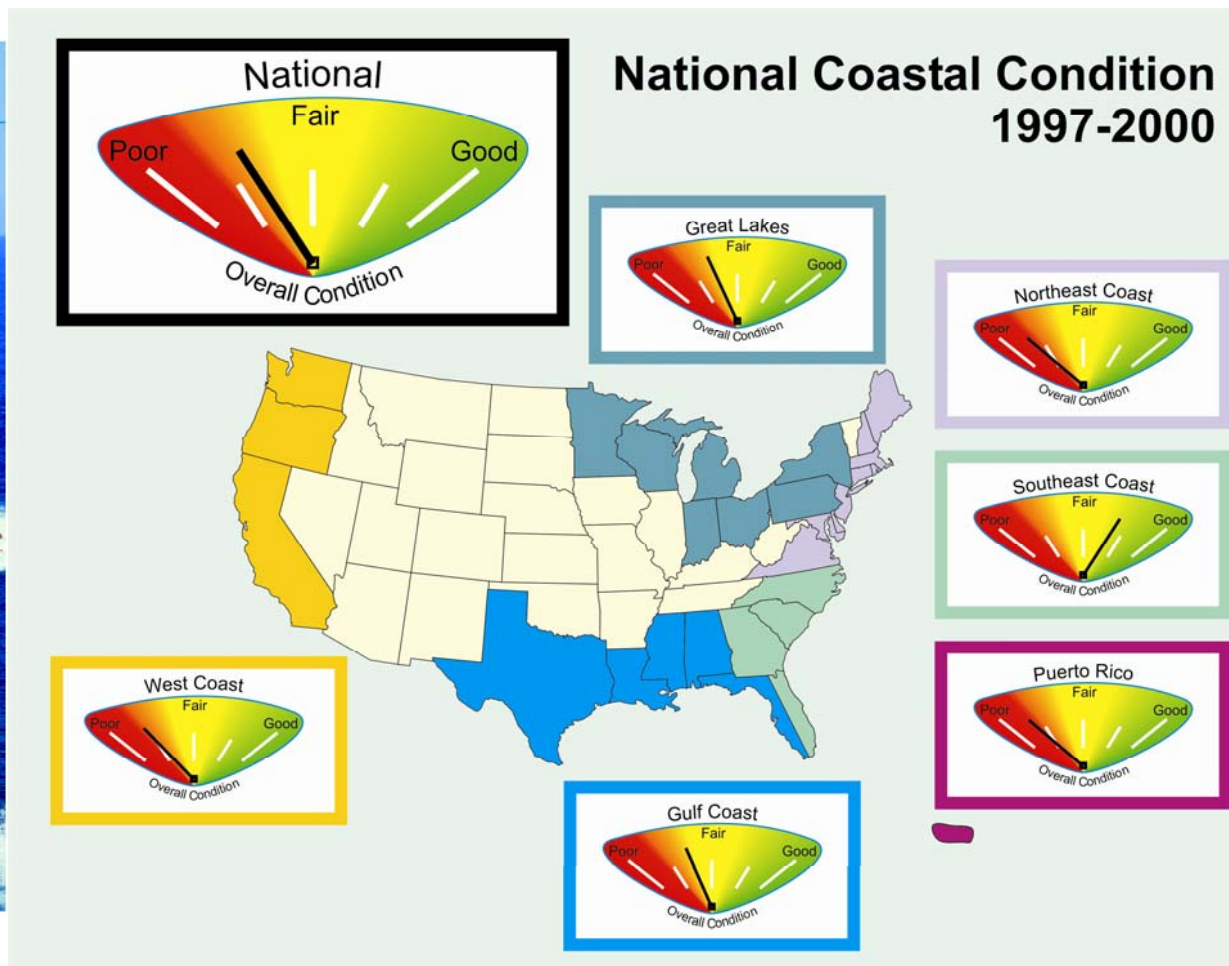
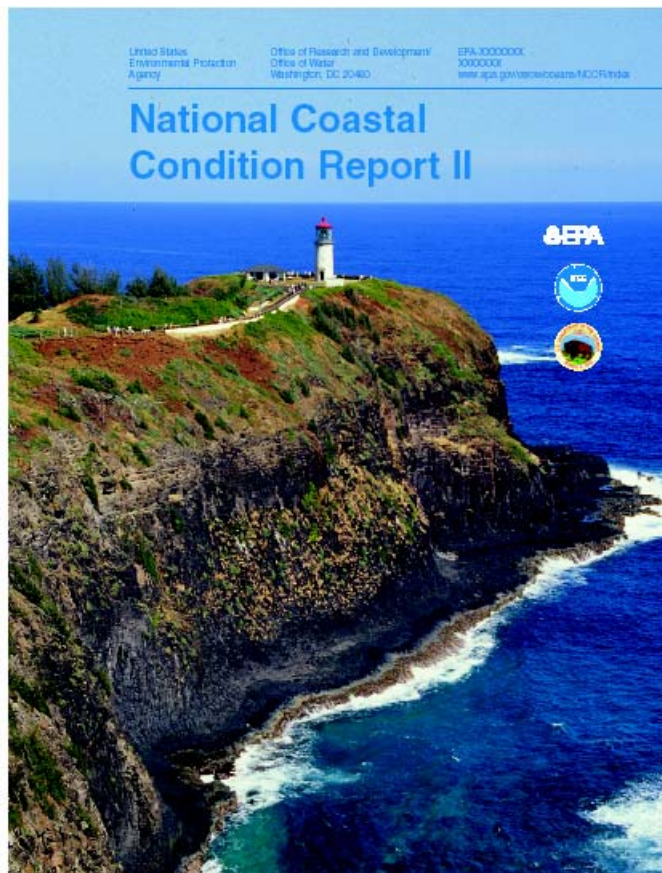
**<http://www.epa.gov/emap/greatriver>**

## *Program and Policy Questions for EMAP*

- What are the current conditions of our national aquatic ecosystems?
- What stressors are associated with biological conditions?
- Where are the conditions improving or declining?
- Are management programs and policies working?



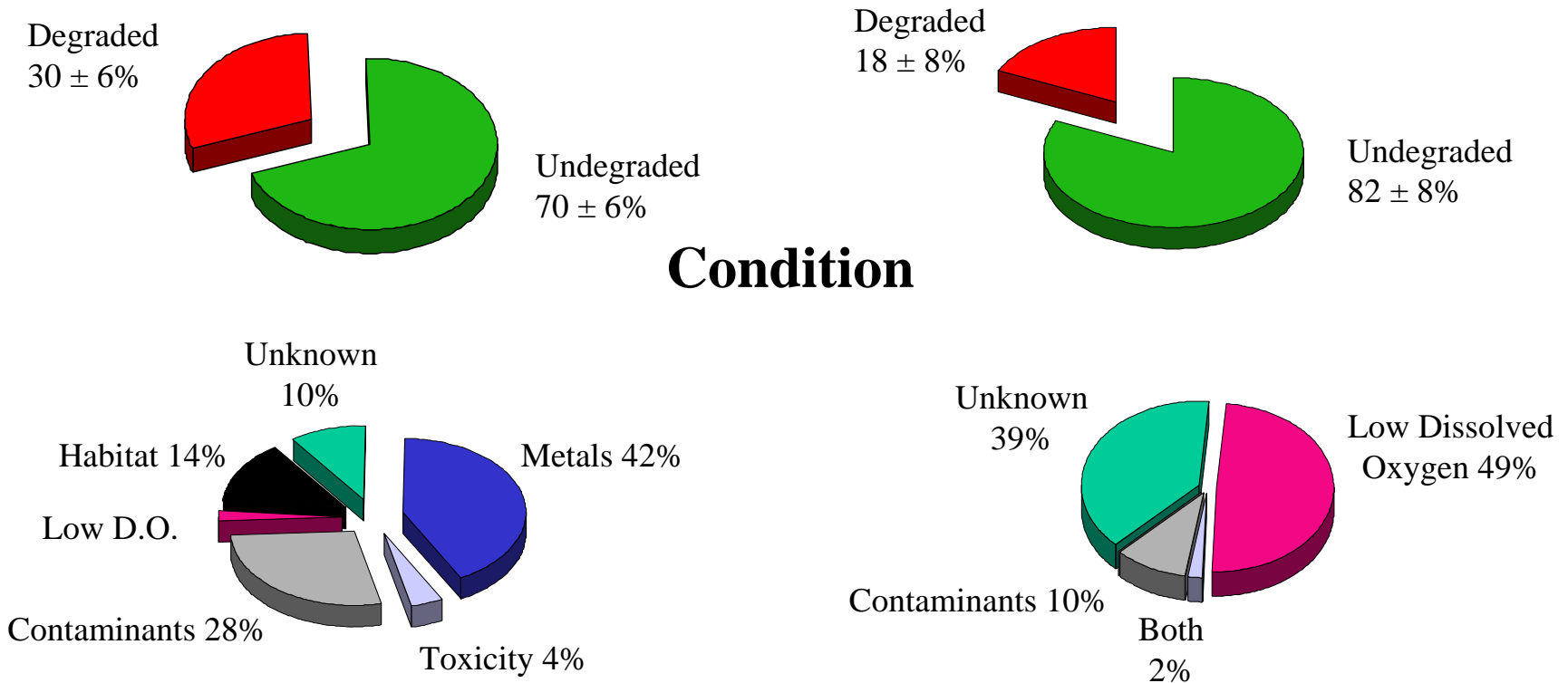
# EMAP - National Coastal Condition Assessment



<http://www.epa.gov/owow/oceans/nccr/2005/downloads.html>

# Comparison of Estuarine Conditions

## Estuarine Benthic Invertebrate IBI



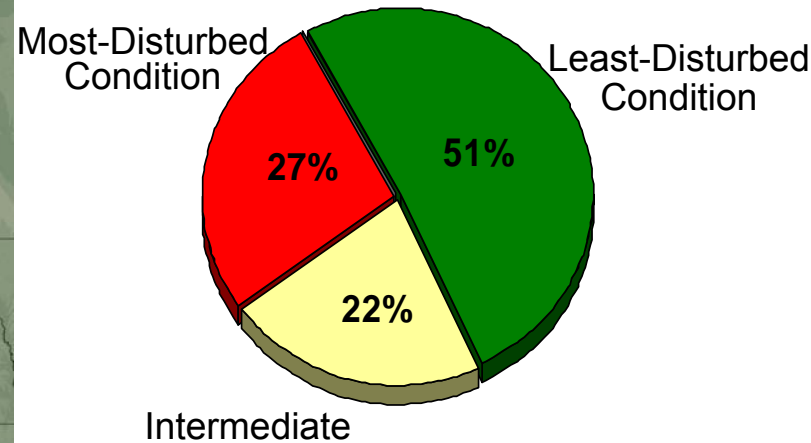
## Stressors Associated with Degraded Condition



# EMAP - Western Streams



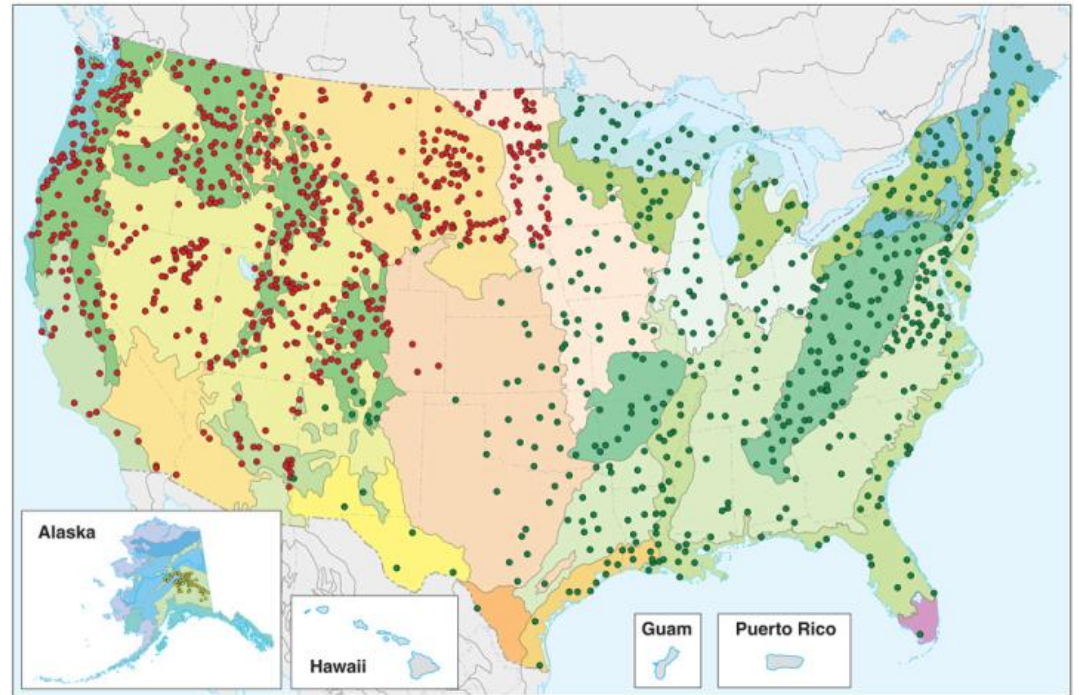
## Index of Biotic Integrity Macroinvertebrates



## Proportion of Stream Length

(margin of error: +/- 4% at 95%)

# *Successful ORD & OW Partnership*



National Report in March 2006



# EMAP-Great River Ecosystems (EMAP-GRE)

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*Develop, demonstrate, and transfer* the scientific basis for consistent, unbiased, cost-effective condition assessments for the Ohio, Missouri, and Mississippi Rivers.

## **Guiding Principles**

Involve stakeholders.

Approach must work across boundaries.

Biology integrates environmental stresses.

Probability surveys provide statistical power.

## **Schedule**

Assessment of Upper MS, MO, and OH Rivers: 2004-2006

Assessment of Lower MS River planned 2007-2009.

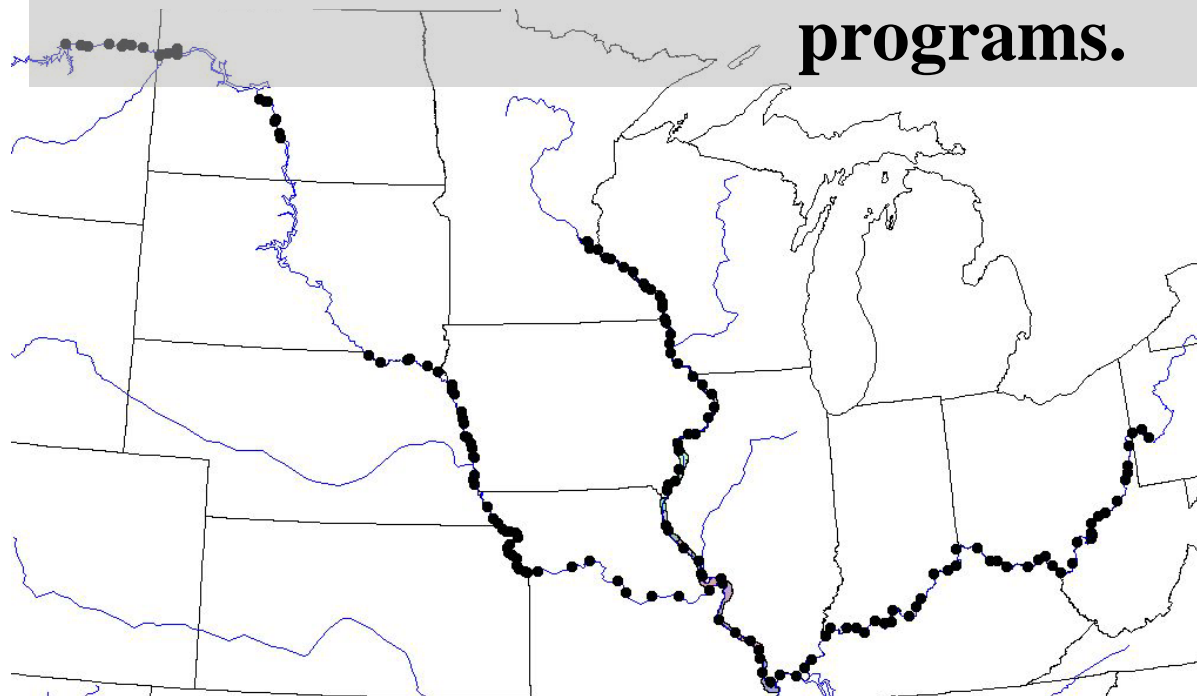
## **Outcomes & Products**

Transfer tools to states to build assessment capabilities.

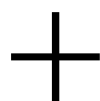
Condition / Assessment Reports

Reference Condition & Indicators Reports

# EMAP-GRE approach is consistent with other EMAP programs.



Designs



Indicators



Assessments

Sample size



Schedule



Assessment units



Resource definition

Implementation



Training & QA



Consensus & evaluation

Bioassessment Framework



Cooperative data analysis



Standards & criteria



Partnerships

# EMAP-GRE Product (extent estimate)

What % ( $\pm$ error) of [resource] in [unit] is in [condition] as indicated by [indicator] ?

<i>Resource</i>	<i>Unit</i>	<i>Condition</i>	<i>Indicator</i>
<b>Main-channel</b> <b>Backwater</b> <b>Floodplain</b>	<b>State</b> <b>River</b> <b>EPA Region</b> <b>Ecoregion</b>	<b>Good</b> <b>Marginal</b> <b>Poor</b> <b>Threatened</b> <b>Impaired</b>	<b>Biotic integrity</b> fish, benthic inverts, zooplankton, algae, vegetation <b>Water Quality</b> nutrients, DO, temperature, turbidity <b>Stressors</b> sedimentation, flow, land use <b>Habitat Integrity</b>

## Challenges

<b>Relevancy</b> <b>Data limited</b>	<b>Sample size</b> <b>Funding</b> <b>Standardization</b> <b>Consensus</b>	<b>Reference conditions</b> <b>Biocriteria</b> <b>WQ standards</b>	<b>Known variability</b> <b>Public interest</b> <b>Cost-effectiveness</b> <b>Standardization</b>
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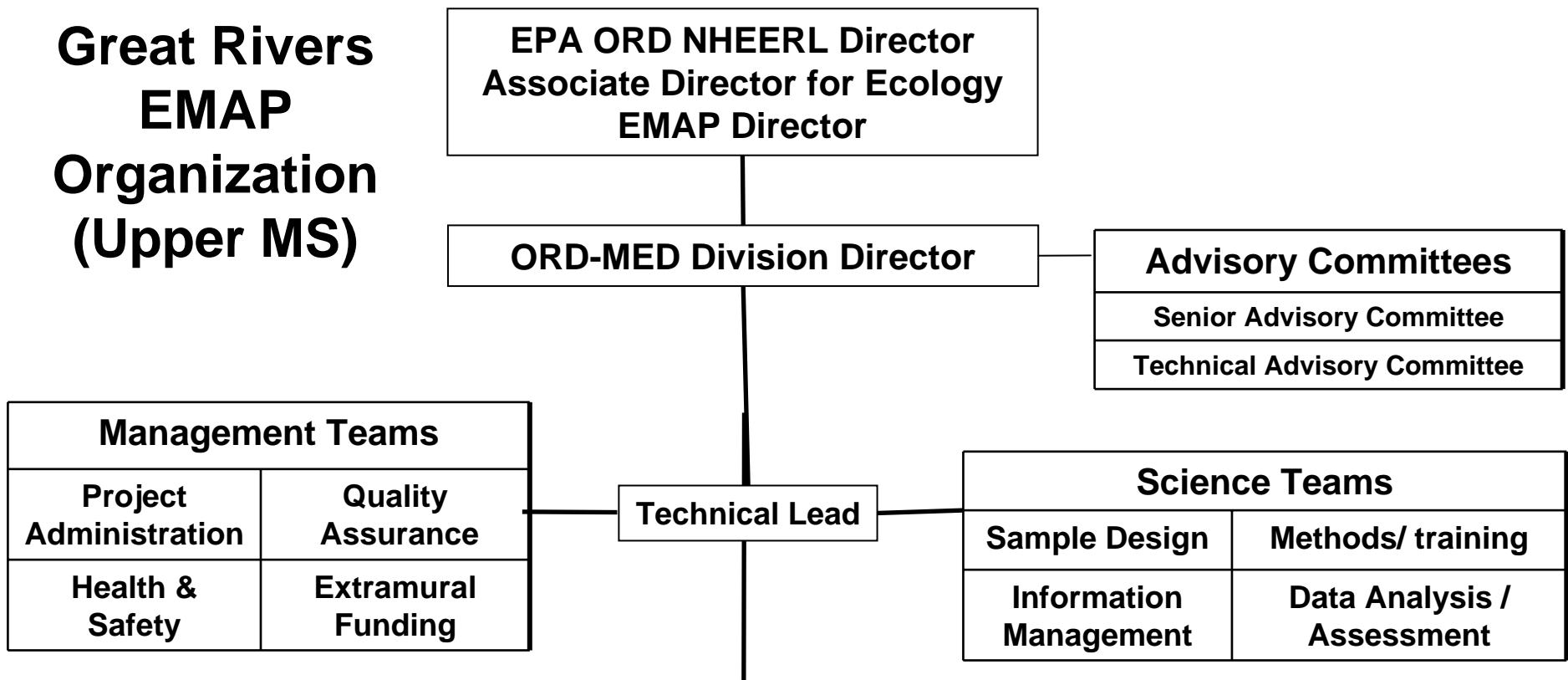
## Example Assessment Questions

What % ( $\pm$ ) of the Missouri River main-channel in Kansas is impaired by [NH<sub>3</sub>]?

What % ( $\pm$ ) of the Mississippi River main-channel in Iowa has blue-green dominated phytoplankton?

What % ( $\pm$ ) of the Mississippi River main-channel margin in Missouri has benthic invert taxa dominated by tolerant taxa?

Great Rivers  
EMAP  
Organization  
(Upper MS)



Partners				
<b><u>Upper Missouri River</u></b> USGS North Dakota & Montana District Offices; North Dakota Dept Health EPA Region 8	<b><u>Lower Missouri River</u></b> USGS Missouri, Iowa, Kansas, Nebraska District Offices; Missouri Dept of Conversation; Nebraska Game & Fish Commission EPA Region 7	<b><u>Upper Mississippi River</u></b> USGS UMESC Wisconsin DNR Minnesota DNR Minnesota PCA Iowa DNR Illinois DNR Missouri Dept Conservation EPA Regions 5 & 7	<b><u>Ohio River</u></b> EPA NERL EPA Region 3 EPA Region 4 EPA Region 5 ORSANO SoBran Inc	<b><u>Analyses</u></b> University of Louisville Stroud Water Center Southwest Missouri State University USGS UMESC EPA NERL EPA MED EPA MED, WED, & NERL contract staff University of Minnesota



# EMAP-GRE is working.

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## **Pro:**

- Representative sampling of current conditions.
- Numerous water chemistry, habitat, and biological variables.
- Methods are consistent.
- Results contribute to reference condition characterization and indicator development.

## **Con:**

- Bioassessment frameworks are undeveloped on great rivers.
- Current approach may be sub-optimal for Lower MS River.
- Limited ability to make site-specific, before-after, or control-impact inferences.

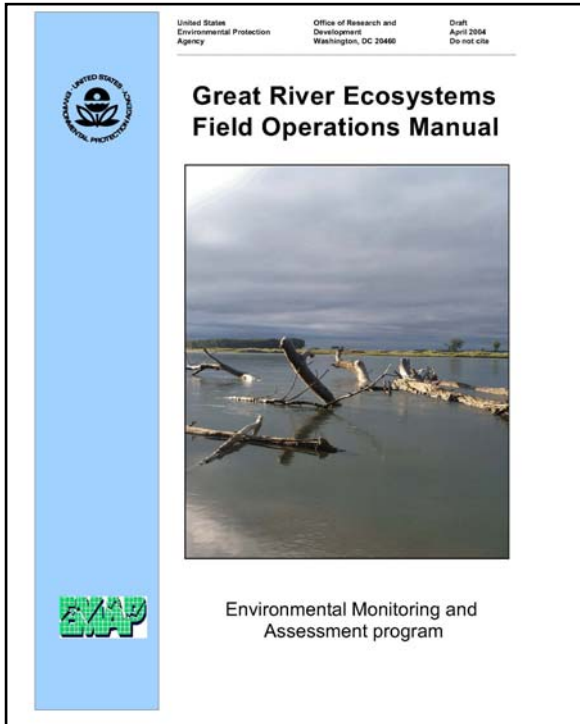
EMAP-GRE is a research program, not an ambient monitoring program.

# ***EMAP-GRE Program Components***

## ***Field Operations***

## ***Manual***

## ***Crew Training***



***Sample Analysis***  
***Data Analysis***  
***Design Support***  
***Information Management***



# Current metrics and indicators

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- **Water Quality**

- Dissolved oxygen
- Dissolved N ( $\text{NO}_x$ , ammonia)
- Conductivity
- pH
- Metals (As, Pb, Se, CU, Fe, Ni)
- Temperature
- Anions & Cations
- Turbidity, suspended matter
- Alkalinity
- Total & Dissolved P, N, & C
- Elemental particle analysis
- Particulate stable isotopes
- Chlorophyll

- **Sediment**

- Enzyme activity
- Toxicity
- Total and volatile matter
- Chemistry

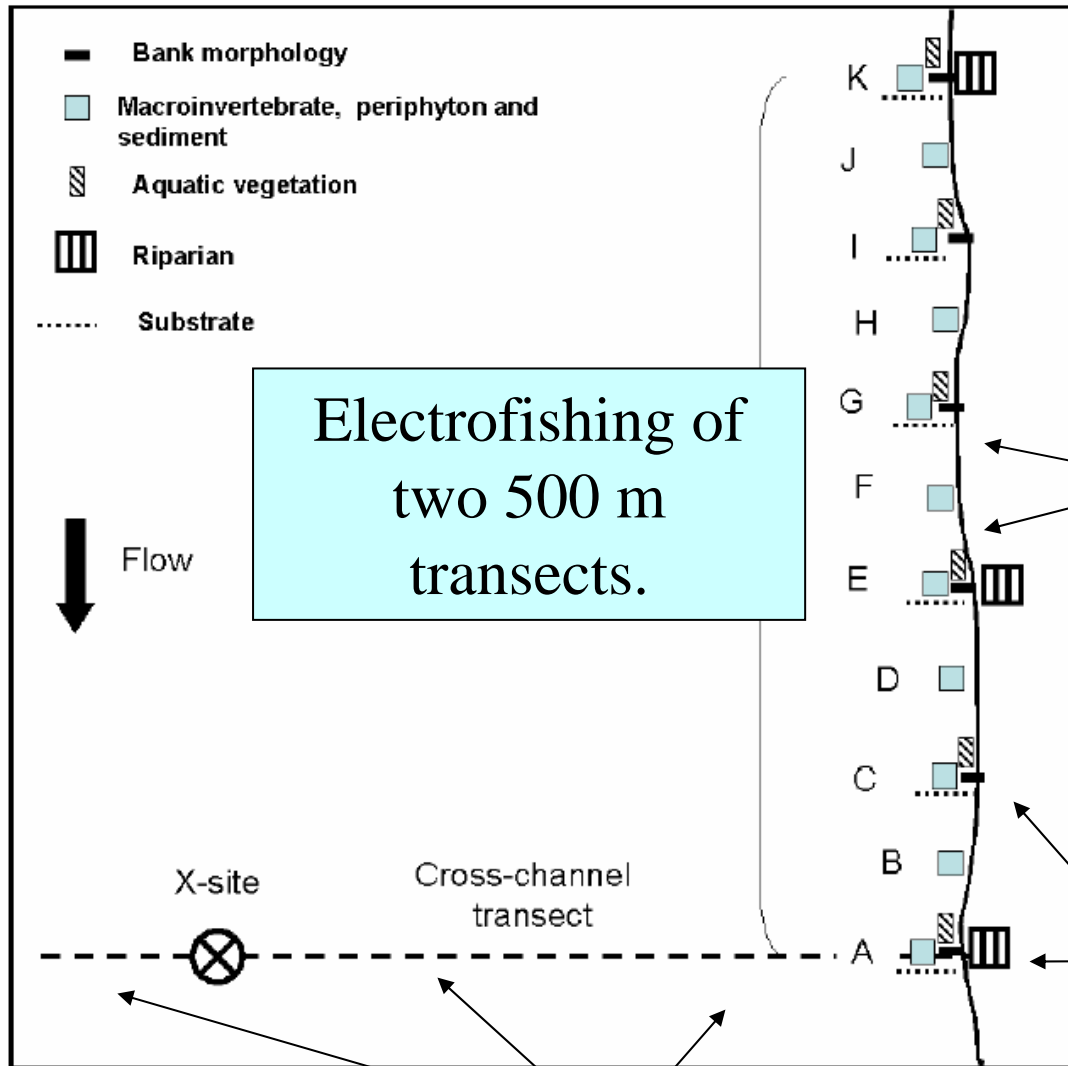
- **Biotic Assemblages**

- Fish
  - Tissue contaminants
  - DNA
- Invertebrates
  - Littoral benthos
  - Snags
- Zooplankton
- Phytoplankton
- Periphyton
- Submersed aquatic vegetation

- **Habitat**

- Littoral
  - Vegetation cover
  - Substrate
  - Woody debris
- Riparian
  - Vegetation cover
  - Invasive/exotic species

# EMAP-GRE field methods on the Upper MS system.



Composite benthos, sediment, and periphyton samples, and habitat data collected at 50 m intervals.

Aquatic and riparian vegetation, and bank morphology data collected at 100 m intervals.

3-9 point composite water chemistry, phytoplankton, zooplankton, DO, turbidity samples



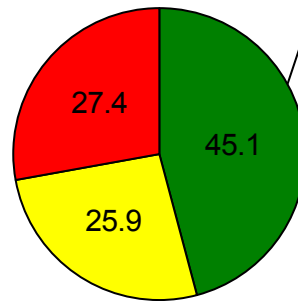
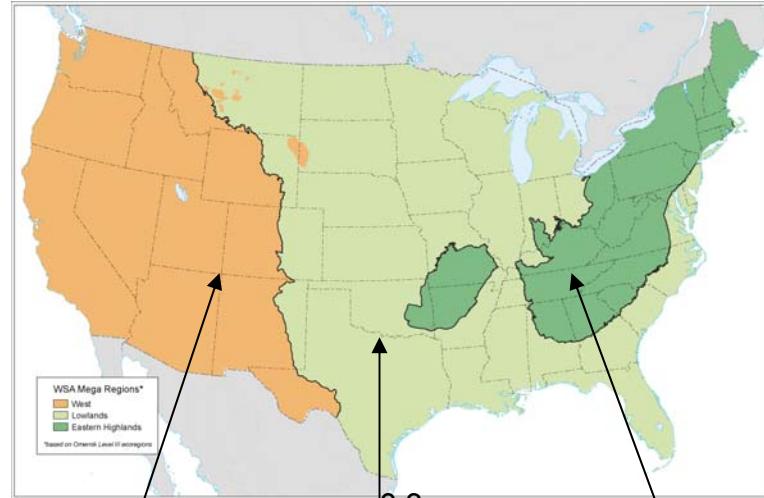
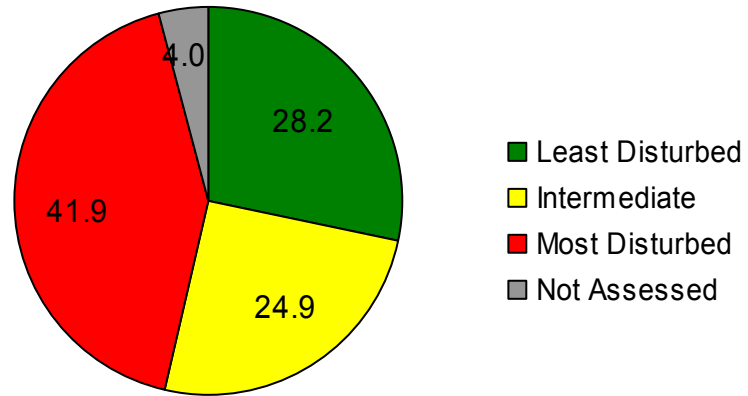
# EMAP

## Assessment Products

### Biotic Condition

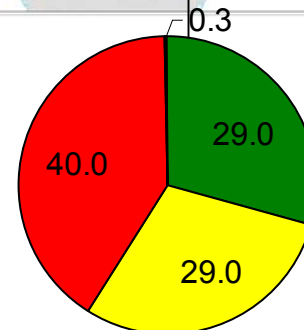
*Regionally- applicable  
Reference-based*

Macrobenthos IBI - "Lower 48"

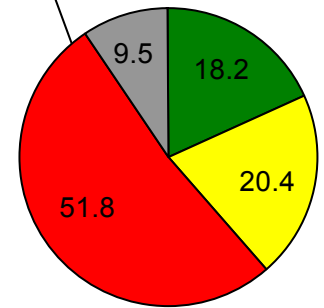


National Stream Assessment data

West  
245,678 km



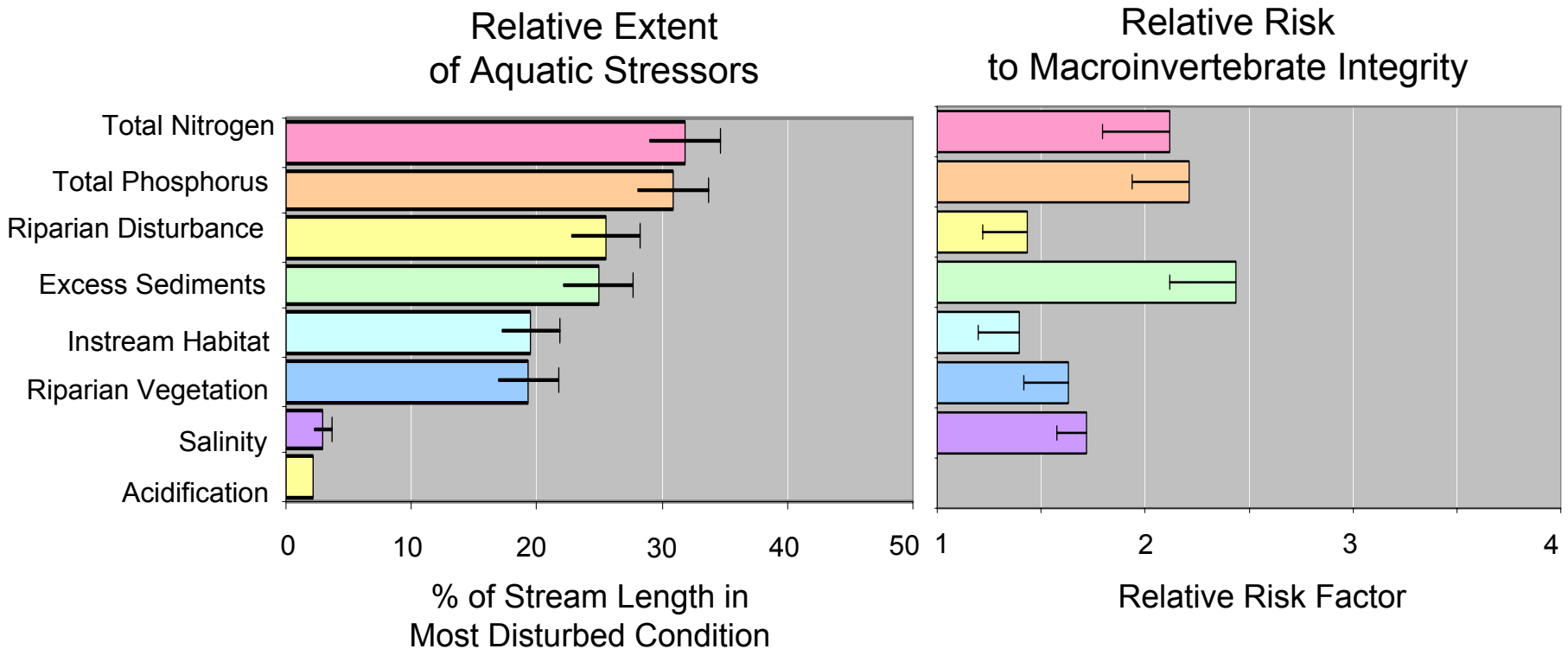
Plains & Lowlands  
390,409 km



Eastern Highlands  
444,668 km

# EMAP Assessment Products

## Extent estimates of stressors and relative risk of biotic condition to stressors



National Stream Assessment data

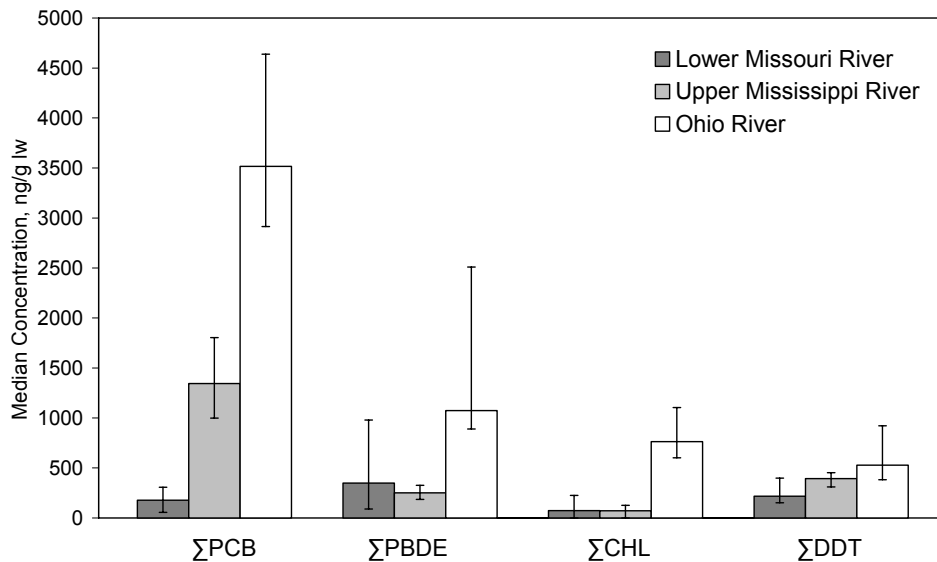


Figure 1. Total PCB congeners ( $\Sigma$ PCB), total PBDE congeners ( $\Sigma$ PBDE), total chlordanes ( $\Sigma$ CHL), and total DDTs ( $\Sigma$ DDT) median concentrations for large fish samples from the Ohio, Upper Mississippi and Lower Missouri Rivers.

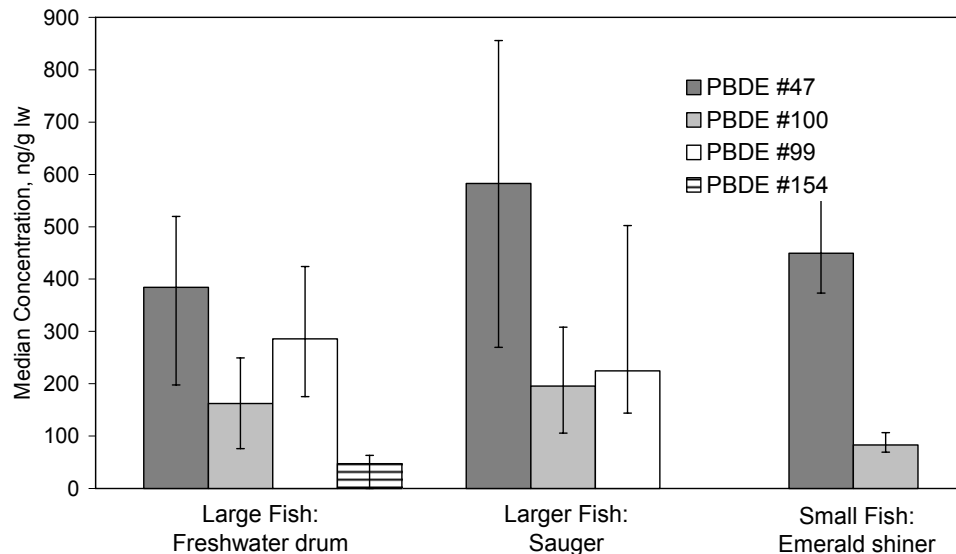


Figure 2. Median congener-specific PBDE concentrations and the 95% confidence intervals for two large fish and one small fish species (with n>9) collected from the Ohio River.

## EMAP-GRE data example: Occurrence of pesticides, polychlorinated biphenyls (PCBs), and polybrominated diphenyl Ethers (PBDEs; flame retardants) in fish

Whole fish were analyzed for found higher concentrations of PCBs, PBDEs, chlordanes, and DDT for Ohio River fish than Missouri River or Mississippi River fishes.

The distribution of PBDE congeners (lower) in fish differs from commercial formulations suggesting difference uptake and/or absorption properties of some congeners by fish.

*Tettenhorst, D.R. et al. (UES Inc contractor to the EPA), 2006. American Chemical Society Symposium*

# **Design considerations for the Lower Mississippi River**

## **Consensus building with LMRCC**

- **Objectives**

- Must produce an EMAP Assessment of river.
- Must support water quality and biological assessment needs of states.

- **Assessment units**

- Must be definable within explicit spatial domains
- Reasonable to complete assessment under EMAP-GRE approach.

- **Sample sizes**

- Must be rationale & practical & statistically sufficient.
- Must incorporate characterization of reference conditions, intra/inter annual variability, and QA requirements.

- **Methods & Indicators**

- Must be relevant, practical, safe, cost-effective, and efficient for the river.
- Must consider compatibility with current EMAP-GRE approach.
- Should not need much exploratory research to implement.

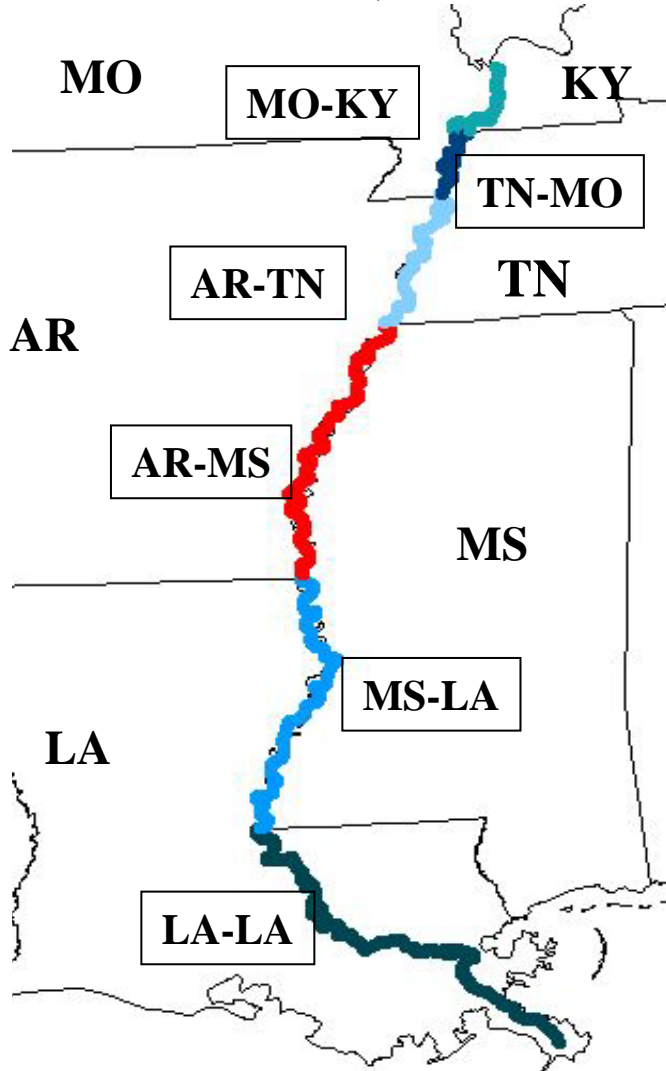
- **Analytical Frameworks**

- Must be developed within partnerships.
- Must develop legacy for river bioassessments.



# Proposed Design for Lower MS River Assessment

The number of sites in each inter-state section and in each state after 3 years. Data from inter-state sections are used by both states for assessments (i.e. sites are double-counted). Does not include QA re-visits.



State	Shares river with	Section length (km)	# Sites in each section	# Sites in each state
LA				
	LA	485	32	162
	MS	324	22	132
AR				96
	MS	334	22	
	TN	181	12	57
MO				51
	KY	100	10	30
	TN	100	7	
TOTAL		1,524	105	

# **Funding EMAP-GRE work on the Lower Mississippi River (2007-2010)**

- State funding through Cooperative Agreements
  - Anticipated total over 4 years: \$ 2.2M (beginning FY07)
  - No required match or cost-sharing.
  - Only state CWA agencies were eligible to apply.
  - Non-competitive, but peer-reviewed, selection process.
  - Proposals received from TN and MS. LA will submit one soon.
  - Work done as collaborations between state agencies and USGS.
- Federal funding through Inter-agency agreements with USGS
  - An existing agreement with MO Water Science Center will be amended.
  - A new agreement is being developed with AR WSC.
  - EPA is encouraging the USGS to involve state partners in states without a cooperative agreement (i.e. AR, KY, and MO).

# Overview of cooperative work in EMAP-GRE

## • EPA will:

- Fund sample collection and lab analyses.
- Track samples.
- Manage data.
- Coordinate consensus building of design and methods
- Provide design (with sites and dossiers).
- Provide field forms & labels.
- Conduct training.
- Conduct audits.
- Coordinate data analyses.
- Lead workshops

## • States/USGS will:

- Manage agreements.
- Assemble & coordinate crews.
- Provide, maintain, and use appropriate gear.
- Participate in methods development.
- Attend training.
- Provide field forms and labels.
- Collect samples.
- Deliver samples & data.
- Review and verify data.
- Promote EMAP for river assessments.